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Groundwater – An Important Rural Resource

PRIVATE RURAL WATER SUPPLIES

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This is the fourth of four Factsheets in a series that will assist Ontario's farmers and other rural residents to learn about groundwater; this one focuses on the different types of private rural water wells that may be found on a rural property or farm.

Other Factsheets in this series include:

- *Understanding Groundwater* (Order No. 06-111)
- *Managing the Quantity of Groundwater Supplies* (Order No. 06-113)
- *Protecting the Quality of Groundwater Supplies* (Order No. 06-115)

Groundwater is a precious resource for rural families and businesses. In some situations, it may be the only water source. Understanding the type of well water supply and the factors and conditions that affect it can help well owners protect and conserve groundwater.

Besides drawing water, one of the key functions of a well is to keep contaminants and surface water out. Proper well construction ensures that surface water cannot directly enter your well and will instead infiltrate and pass downward through the soil before it can enter your well (see Figure 1, next page). A secure lid prevents direct entry of surface water, dust, debris and vermin. Mounded-up soil around the wellhead directs water away from the well casing, and the watertight grout in the space around the well casing prevents surface water from easily moving down along the side of the well casing and into the groundwater.

Surface water can sometimes be contaminated, and the soil will help to filter and clean infiltrating water. This is explained in more detail in an information kit from the Ministry of Health and Long-Term Care, *Keeping Your Well Water Safe to Drink: An Information Kit to Help You Care for Your Well* (Order No. BMP 12K).

TYPES OF WELLS

It is important for well owners to know or find out what kind of well they have, including how it was built and its basic operation. This information is summarized in a water well record that was created when the well was built. Contact the Ministry of the Environment at 1-888-396-9355 to obtain a copy of the water well record that was filed when the well was constructed. If the water well record is not available, there are other ways to determine the type of well. Important information for identifying well type is summarized in Table 1, below.

Note: Sometimes wells exist, but no casing is visible. In the past, drilled and sand-point wells were sometimes buried or constructed in pits. Also, drilled wells were sometimes constructed in the bottom of large-diameter wells acting as pits.

TABLE 1. Visual characteristics of different well types

Casing size	Well type
Small-diameter: 10–20 cm (4–8 in.)	Drilled well (most locations)
Very small-diameter: 2.5–5 cm (1–2 in.)	Sand-point well (if located in a shallow, sandy area) *Note*: Natural gas wells use similar-type casing.
Large-diameter: 60–120 cm (24–48 in.)	Indicates a large-diameter well, often called a bored or dug well

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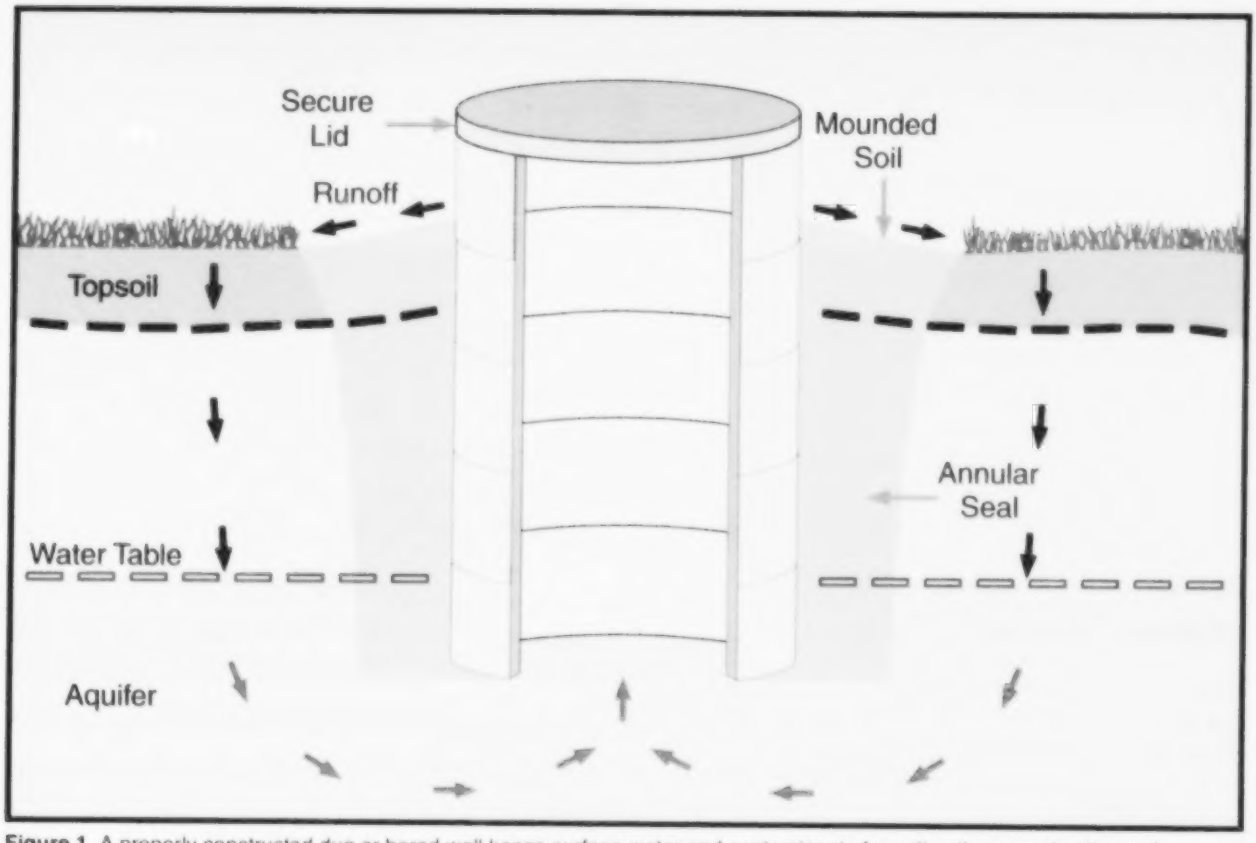

Figure 1. A properly constructed dug or bored well keeps surface water and contaminants from directly accessing the well.

Small-Diameter Wells

Drilled Wells

A drilled well consists of a small-diameter casing ranging in size from 10–20 cm (4–8 in.). Drilled wells can obtain water from both overburden and bedrock aquifers. Overburden wells include those constructed into overburden aquifers (the geological materials above bedrock), composed typically of sands and gravels, but may also be constructed in silts and clays.

Most water wells are constructed with a well screen that allows groundwater to enter a well while keeping sand and materials out. A properly constructed, screened overburden well is shown in Figure 2, next page. Well screen openings are sized carefully to allow sediment-free water to flow efficiently into the well and improve the connection between the well and aquifer. Wells are "developed" during construction by the contractor to ensure that water is sediment-free. The contractor will pump the well for an extended period and agitate water (also called surging) in the well, to remove fine-grained sediments from the area of the aquifer close to the screen.

An unscreened, poorly screened or poorly developed well is usually less efficient to operate and more difficult to maintain than a screened well, because sediment can enter the well. Sediment can plug the well, increase the frequency of well maintenance or replacement, reduce pump life because of greater use and abrasion, damage the pump and generally increase pumping costs.

> Aquifers are permeable formations, composed of geological materials, that will yield useful amounts of water when pumped for water supplies. Aquitards (or confining layers) are made up of materials with low permeability, such as layers of clay and shale, that prevent any significant movement of water. The significance of aquifers and aquitards is explained further in the first Factsheet of this series, *Understanding Groundwater* (Order No. 06-111).

Bedrock wells are drilled down through the overburden and into the bedrock. The portion of the casing that extends from the ground surface to the top of the bedrock is often cemented at the bottom to ensure a good seal and avoid leakage of water from the overburden into the well. A well screen is usually not used where bedrock is sound but may be installed to stabilize the drill hole if the rock is highly fractured or unstable and likely to cave in. Drilled bedrock wells, like drilled overburden wells, are developed during construction to ensure sediment-free water.

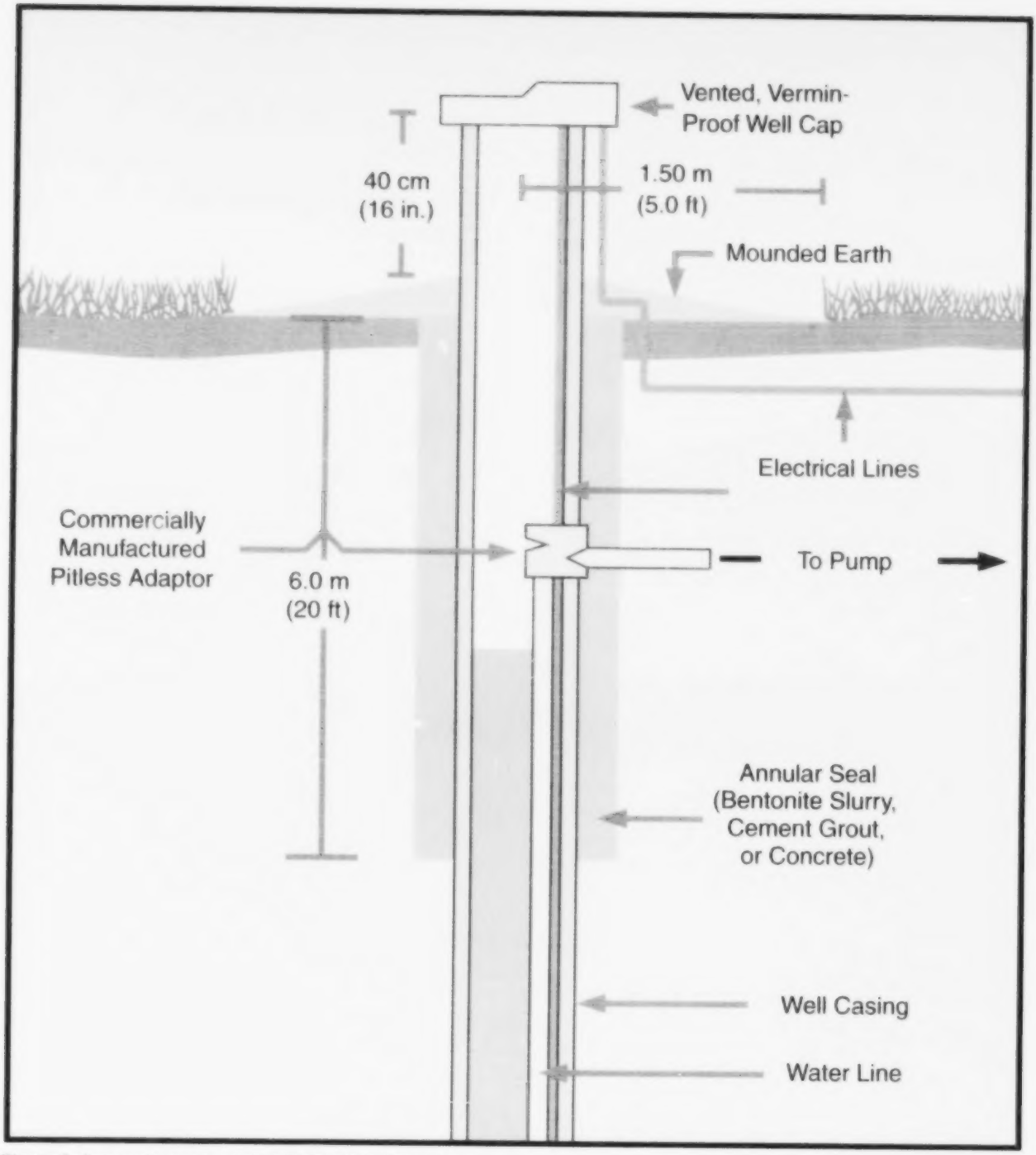

Figure 2. A properly constructed, drilled overburden well.

A properly constructed and maintained drilled well should prevent the entry of any foreign substance into the well casing that might impair water quality. When a well is drilled, an annular space is created into which the well casing will be placed. The annular space should be sealed with a suitable grout, bentonite or equivalent commercial or clay slurry. The casing should be watertight and made from approved materials, and the joints should be welded or properly sealed. This watertight method of construction, along with the best management practices shown in Figure 2, make drilled wells the least vulnerable to contamination.

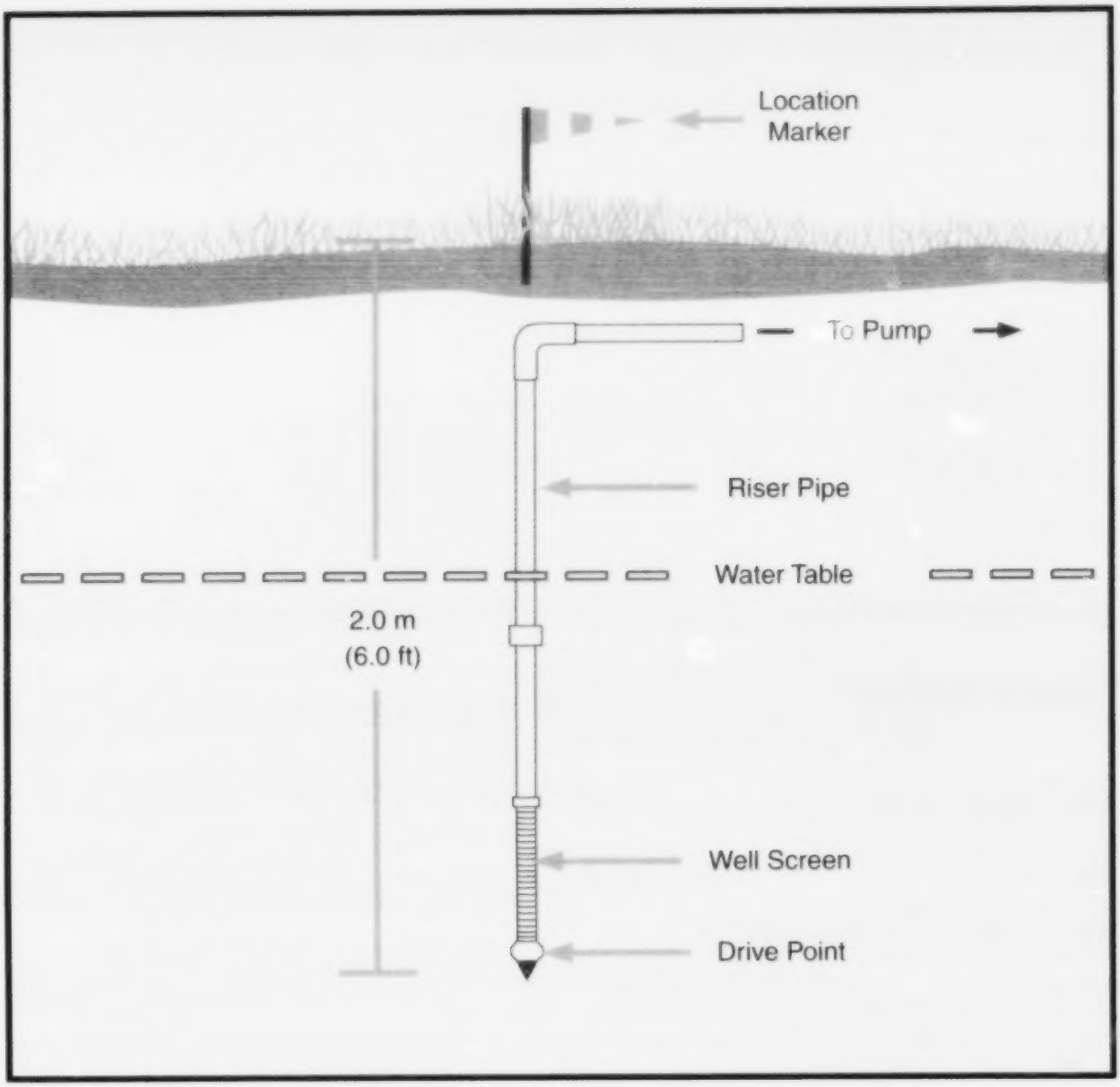

Figure 3. Construction of a sand-point well.

Existing drilled wells that do not meet the specifications in Figure 2 can be upgraded in many ways. Here are some examples.

- Extend the well casing above finished ground surface by at least 40 cm (16 in.). Where a drilled well is located in a well pit, the well pit casing (e.g., concrete tile) should be removed, the casing extended above the ground surface and the excavation properly backfilled and sealed.
- Using soil, mound the surface of the ground around the well casing to direct surface water away from the well.
- Cover the top of the casing with a commercially manufactured, vermin-proof well cap.

A checklist including these and other best management practices is provided in a kit along with the Water Wells Best Management Practices book, *Keeping Your Well Water Safe to Drink: An Information Kit to Help You Care for Your Well* (BMP 12K).

Sand-Point Wells

Sand-point or driven-point wells consist of a small-diameter casing ranging in size from 2.5–5 cm (1–2 in.). Sand-point wells are constructed in sand and

gravel aquifers and are either driven or jetted (inserted using high-pressure water) into the ground. Sand-point wells are usually only installed where the aquifer has a shallow water table and contains few or no stones.

Figure 3, previous page, shows the construction of a typical sand-point well. Because of the type of construction (driven or jetted into place) and the type of aquifer (unconfined, shallow, sand or gravel), sand-point wells are considered highly vulnerable to contamination. Contaminants on the ground surface have only a short distance to travel before reaching the water table and the well inlet.

Large-Diameter Wells

Large-diameter wells are typically constructed with prefabricated concrete tile or corrugated galvanized steel pipe ranging in diameter from 60–120 cm (24–48 in.). Older wells may be constructed of brick, stone or even wood cribbing and are very susceptible to undesirable surface-water seepage through the portion of the casing located above the water table.

Dug wells, which were often hand-dug in the past, are now constructed primarily with excavation equipment. They are usually no more than 9 m (30 ft) deep. Bored wells are constructed with the use of a boring machine. The average depth of bored wells is 15 m (50 ft), but some are 30 m (100 ft) deep. An example of a properly constructed large-diameter well is shown in cross-section in Figure 4, below.

Existing large-diameter wells can now be made of metal or approved plastic casing, where the joints are made watertight by welding or sealing with a waterproof material. Large-diameter wells in general are more vulnerable to contamination than drilled wells. This is because of potential leaks in the casing joints and the difficulty of grouting the well's annular space properly. All large-diameter wells should be capped with a safe cover to prevent unwanted access by water, vermin or other contaminants to the well's interior.

Shallow large-diameter wells — extremely shallow wells (less than 3 m or 10 ft deep) in particular — may also experience the added problem of low water levels during extended periods of low precipitation. The result may be a reduction in the amount of water that a well can provide, or the well may go dry. More information about managing private wells during times of low precipitation is presented in the OMAFRA Factsheets *Managing the Quantity of Groundwater Supplies* (Order No. 06-113) and *Private Water Well Owners – Dealing with Water Shortages* (Order No. 99-025).

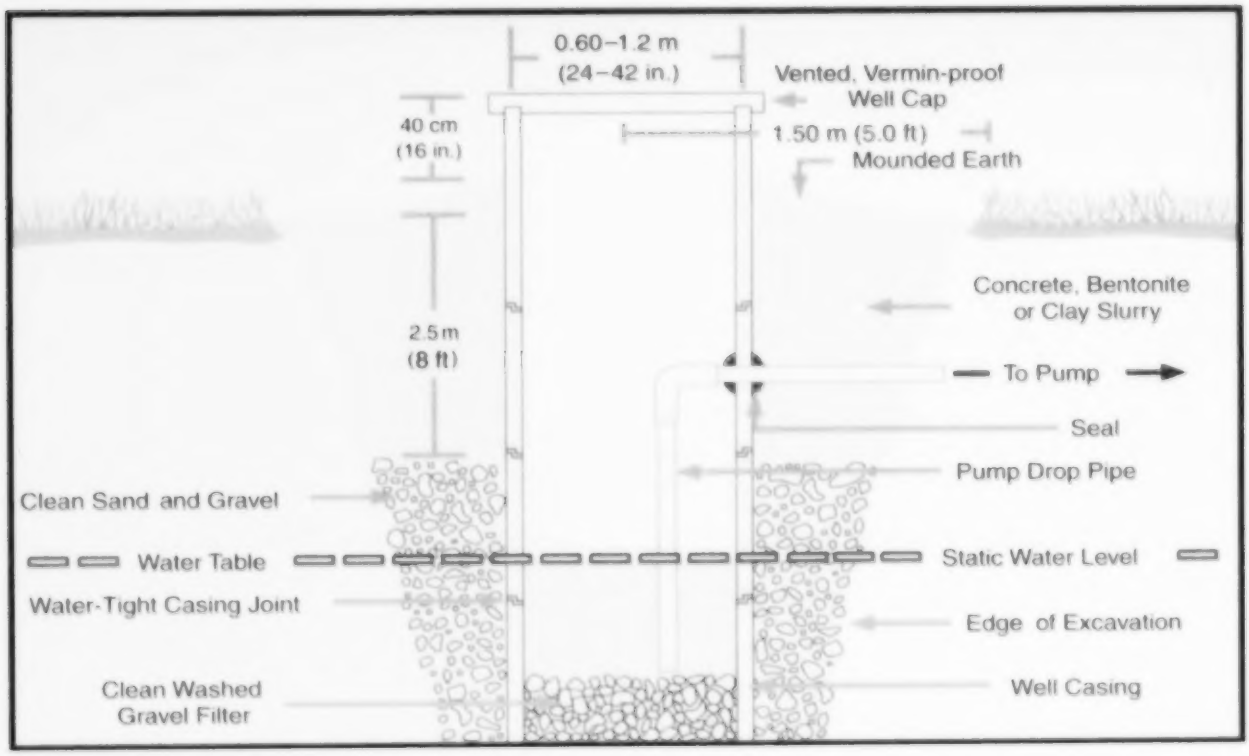

Figure 4. A properly constructed large-diameter well.

HIGHLY VULNERABLE WATER SUPPLIES

The risk of water quality problems with groundwater supplies is directly related to the type of well, its state of repair, its depth and how close it is to potential sources of contamination. This is the general rule: the deeper the well, the longer it will take for surface water to enter the well, which lessens the risk of contamination. The risk of contamination also decreases as the distance between the well and potential contamination sources increases.

Water supplies can be highly vulnerable to contamination due to a number of factors, including:

- inadequate depth of soil protecting the aquifer
- direct and rapid movement of surface water into the well casing and aquifer
- a shallow groundwater source easily influenced by surface activities or water
- a well that is located in a low area subject to ponding and/or flooding, or near or downslope of a potential contaminant source(s)

More information about groundwater vulnerability is presented in the OMAFRA Factsheet *Protecting the Quality of Groundwater Supplies* (Order No. 96-115) and *Keeping Your Well Water Safe to Drink: An Information Kit to Help You Care for Your Well* (BMP 12K).

Highly vulnerable water supplies include:

- extremely shallow- or large-diameter wells, i.e., less than 3 m (10 ft) below ground surface
- below-grade wells, including well pits, that are constructed where the top of the well casing is below ground level, such as:
  - buried wells (including those constructed beneath a structure)
  - well pits (drilled wells constructed in excavations below the frost line), drilled wells in well pits that are below grade and subject to flooding
  - drilled wells constructed in old large-diameter wells
- cisterns (reservoirs used to collect and store water)
- springs and spring boxes constructed around a spring to collect water for more efficient pumping — spring water is highly vulnerable to contamination from natural and human sources where it flows close to the ground surface
- surface-water trench systems, also known as "shore wells"

Highly vulnerable water supplies should be used only where attempts to develop an alternative water supply have not been successful. They should be located as far as possible from any potential source of contamination. If the water supply is highly vulnerable, do not use it before having it tested and treated. Testing and treatment options are discussed in *Keeping Your Well Water Safe to Drink: An Information Kit to Help You Care for Your Well* (Order No. BMP 12K).

UNUSED WELLS

Unused or improperly abandoned wells are a significant potential source of contamination. Abandoned wells should be properly decommissioned (plugged and sealed) to protect the aquifer from the direct entry of surface water and contaminants. Decommissioning also prevents the movement of water and contaminants between aquifers, or between an aquifer and the ground surface, and eliminates a safety hazard to humans and animals.

In Ontario, unused or improperly abandoned wells must either be upgraded to meet regulatory requirements or be properly decommissioned.

OTHER SOURCES OF INFORMATION

OMAFRA Factsheet, *Private Well Owners – Dealing with Water Shortage*, Order No. 99-025.

OMAFRA, *Best Management Practices: Water Wells*, BMP 12.

Ontario Ministry of the Environment, *Well Aware – A Well Owner's Guide* (videotape).

Ontario Ministry of Health and Long-Term Care, *Keeping Your Well Water Safe to Drink: An Information Kit to Help You Care for Your Well*, BMP 12K.

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FOR YOUR NOTES

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